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Article

Strengthening Sensory Sustainability Science—Theoretical and Methodological Considerations

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Abstract: Sustainability science is marked by a quarter century of conceptual and methodological development. Based on innovative approaches, such as transformative transdisciplinarity, sustainability science makes the claim to contribute solution-oriented knowledge to sustainable development. Despite successful expansion and promising experiences, there are limitations to be considered. This article argues that the multisensorial reality of human life in socio-material practices has not been adequately captured in sustainability science. Theoretical approaches addressing the sensoriality and corporality of human existence as well as methodological approaches of ethnography and arts-based research to access relevant human dimensions beyond the cognitive are discussed, and the perspective of sensory sustainability science is sketched.

Keywords: sustainability science; sensory studies; arts-based research

1. Introduction

The guiding vision of sustainable development introduced by the groundbreaking report of the Brundtland commission in 1987 and concretised in the Agenda 21 by the international community at the UN world summit on environment and development in Rio de Janeiro in 1992, has stimulated innumerable sustainability activities until the present day. The scientific community has, in part, picked up the challenge: Sustainability issues are dealt with in a broad range of disciplines from business administration (sustainability management) to chemistry (sustainable chemistry), and beyond disciplinary activities, the paradigm of inter- and transdisciplinary sustainability science has emerged and has started to be institutionalised over the past two decades [1,2]. The adoption of the Transformation Agenda 2030 with the global sustainability goals in 2015, which provides a renewed framework for sustainable development till 2030, confirms the ongoing efforts [3]. However, despite this evolution in discourse and practice, the persistence of unsustainable developments is significant [4]. From an ecological perspective, planetary boundaries are transgressed or threatened to be transgressed [5], economic and financial systems are continuously at risk from volatility and crisis and substantial social inequality is causing tensions and social conflict within and between nation states [6]. Based on this well-grounded and extensively documented analysis of unsustainable developments, it is hardly surprising that there is a widely shared conviction between sustainability scientists on the need to deepen and speed up the transition towards sustainability. In this article, it is discussed to what extent sustainability science conceptually and methodologically should and can be widened to strengthen its role within sustainable transformation. It is argued that sustainability science needs to become more sensory. Beyond pioneering works in sustainability science, which explore the potential of arts for sustainable development [7–10] or ideas of mindfulness [11], this article presents conceptual and methodological considerations for sensory sustainability science, which are based on insights from the sociology of senses and sensory studies [12], practice theory [13] and theories of atmosphere [14] and resonance [15], sensory ethnography [16] and arts-based research [17]. Thus,

the article pursues the goal of building a bridge between sustainability science and theories and methodological perspectives from neighbouring social sciences and humanities. This is done by discussing in more detail theories and methodological approaches which are considered as particularly relevant for a sensory perspective. It is not aimed at presenting a systematic literature review, nor is the focus on performing an evaluation of the pioneering arts-based and sensory-oriented projects in sustainability science. At the end, an outlook is given on the potential of sensory sustainability science. In order to set the stage for the argument that a sensory perspective should be systematically strengthened, a brief introductory overview of the core ideas and approaches in sustainability science is presented in the next section.

2. Sustainability Science—A Quarter Century of Conceptual and Methodological Developments

Sustainability science emerged as an academic field of research, teaching and practical engagement at the beginning of the 21st century. Its official starting point can be seen in the world congress “Challenges of a Changing Earth” 2001 in Amsterdam. At this conference, four leading international research programs representing natural science and social science networks gathered and discussed environmental and development issues: The International Science Council (ICSU), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change and the World Climate Research Programme (WCRP). The conceptual and methodological approach of sustainability science was officially presented at this conference. Key figures, such as William Clark, Robert Kates and others, had elaborated the perspective of sustainability science beforehand in an article published in *Science* [18]. Since then, sustainability science has progressed with its institutionalisation, manifested in academic journals, study programs, research programs, schools and faculties, academic positions etc. Even though it still can be debated if sustainability science is an academic discipline in a narrow sense or rather a multidisciplinary academic field focusing on cross-cutting sustainability challenges, there are three core features widely shared within the international “movement” of sustainability science. First, sustainability science is considered as a multi-, inter- and transdisciplinary academic activity, creating not only academic insights, but engaging in co-producing practical knowledge together with societal actors; second, sustainability science has an explicit normative core due to its orientation to the value-laden guiding vision of sustainable development; third, beyond the analysis of problems, there is a strong solution-orientation in sustainability science. These epistemic features which have shaped sustainability science since its official “inauguration” in 2001 are rooted in prior reflections in the context of academic engagement with sustainable development. In connection to the emergence of sustainable development as an important global issue, the fundamental participatory direction of the Agenda 21 and the call on science to contribute has triggered conceptual and methodological innovations especially in environmental science and environmental-oriented social science. Interdisciplinary research on sustainability issues as well as participatory research have been explored by many academic institutions around the world [19]. Roughly four lines of research activities can be differentiated.

Of key importance for the emergence of sustainability science was, and still is, conceptual work. Based on previous insights in environmental science emphasising in the 1970s the need to cross disciplinary boundaries between natural science and social science through which the idea of socio-ecological systems emerged, and driven by the UN-led initiatives to bridge environmental and development issues, conceptual work started to shape sustainability research in the 1990s [20]. Up until today, a broad variety of conceptual perspectives have evolved. The spectrum is wide and differentiated and builds on pre-sustainability discourses in disciplines such as ecology, sociology or economics, for example: Deep ecology, for instance, argues for a fundamental eco-centred cultural shift [21]; ecological modernisation is focused on the need and possibility of adjusting current structures, technologies and practices [22]; post- and degrowth conceptualisations question the possibility of sustainable development in capitalist market economies [23]; the perspective of environmental justice respectively just sustainability, highlights social inequality [24]; and transition management aims at

providing a conceptual perspective for the analysis and design of sustainability transitions [25]. Next to these kinds of conceptual proposals, which continue to shape research on sustainable development, there are some approaches aiming at systematising and orienting sustainable development discourse and practice. Firstly, there are considerations concerning the multidimensionality of sustainable development. Reflecting on the basic idea of sustainable development to approach intertwined social, economic and environmental challenges, different pillar models have been elaborated. Kopfmüller et al. [26] differentiated three (potential) types: The one-pillar model puts an emphasis on the ecological pillar as fundamental to the social and economic pillar; the additive pillar model means the consideration of sustainability concerns in each of the three pillars; and the integrative model represents an understanding of interrelated social, economic and environmental challenges which require a systemic *modus operandi*. Other authors' works connect to the integrative model, but introduce culture as an additional dimension [27]. This conceptual work can help sustainability research to orient itself. Next to the pillar conceptualisation, the discourse on strong vs. weak sustainability is of basic relevance for sustainability research [28]. Therein it is discussed from the perspective of ethics to what extent natural capital can be substituted by technological innovation (weak sustainability) and to what extent nature must be preserved or restored for coming generations (strong sustainability). This diverse conceptual work of the past quarter century has stimulated and framed sustainability research. Despite significant differences, for example regarding the role of technology or the relevance of specific actor groups for (un-) sustainable development, all approaches share the normative orientation towards approaching social, economic and environmental dynamics to safeguard life-supporting natural conditions on earth and improve quality of life. In addition, systemic views are widely shared as well with regard to the need to take into account co-evolving developments if changes that are more or less fundamental are seen as necessary [29]. Hardly considered especially in key conceptual perspectives such as ecological modernisation, pillar models or transition theories are the multisensorial dimension of human life. The human side within the human–nature interface is overwhelmingly conceptualised in terms of values, institutions, awareness and behavior, with a bias towards cognitive-rational presupposition. Partly interwoven, partly as a parallel development to the conceptual work trying to grasp the socio-material complexity of (un)sustainability are methodological approaches addressing sustainable development as a systemic challenge [30].

Drawing on early works of systems analysis, this line of research aims at bridging social and natural systems and engages in system modelling in order to gain a better understanding of (un)sustainable developments and interrelated dynamics [31]. Even though qualitative elements have been integrated into quantitative modelling in many studies, these types of systems analysis reconstruct the human–nature interaction mostly at a relatively abstract level, and its findings are represented in technical models and a technical language using terms such as feedback loops, tipping points, leverage points etc. The strength of this approaches lies in its bird's-eye view, which helps to gain a clearer view on key elements and its fundamental interrelationships. However, like in every perception of the world, scientific and non-scientific alike, systems approaches are selective as well and have their blind spots. Looking from the perspective of interpretative (environmental) social sciences and social constructionism [32], which focuses on the potential of humans to actively make sense of their lifeworld, it can be criticised that systems analysis underestimates the contingency of human action based on interpretative processes. This is even more problematic, if it is considered that sense-making and related human action—like it will be argued in this article—in most situations might not be viewed as cognitive rational—in the sense of conscious cost–benefit evaluations—but as shaped by multisensory processes in embodied practices [33]. This aspect is relevant if sustainability science is not only about analysing abstract system dynamics but aims at supporting concrete societal transformations towards sustainable development: Changes depend on cognitively, emotionally and bodily humans, which are socially, culturally and materially embedded.

Parallel to the research strand of systems analysis, modelling participatory research has developed over the past decades [34]. Based on critical perspectives on technocratic bourgeois science which led

to approaches of action research aiming at intervening into societal issues by collaborative approaches between scientists and citizens, a participatory research paradigm with a great variety of tailored formats has begun to emerge since the 1970s. This methodological perspective has its roots in debates on expertise and counter-expertise, the deconstruction of scientific knowledge claims and the recognition of pluralistic forms of knowledge from folk wisdom to professional knowledge [35,36]. In addition, beyond the reflection on differently constructed types of knowledge, the interrelation between knowledge, values and interests has been addressed. Scientific knowledge, as “true” as it might be, ought not to determine societal decisions. Cultural values need to be considered, if democracy and not technocracy is the guiding vision of a society [37]. Thus, participatory research aims at providing ways to integrate pluralistic knowledge claims as well as value orientations and diverging interests. This normative and methodological understanding of participatory research fits perfectly to the inherently participatory logic of sustainable development as outlined in the Agenda 21. Therefore, it is not surprising that participatory approaches have played an important role in sustainability research and sustainability sciences from early on. Given the normative core of sustainable development, its socio-material complexity and the orientation towards solutions beyond mere problem analysis, participatory research designs have been widely employed. Nowadays, the landscape of participatory (research) methods is very differentiated [38]. Of special interest for sustainability research are those approaches which aim at combining systems analysis and modelling with participatory elements [39]. In order to grasp the systemic and anticipatory characteristics of sustainable development methods, such as participatory modelling, as well as the use of systems analysis within participatory processes for problem identification and solution development are particularly relevant. However, despite the added value of participatory sustainability research to complete and balance scientific knowledge production and technocratic decision-making, it has its limits as well. Participatory approaches follow overwhelmingly, explicit or implicit, the ideal of rational discourse. This leads not only to the risk of a middle-class bias in participatory procedures, but it also poses a challenge to considering adequately the multisensorial experiences and realities of humans beyond cognitive reflection and expression. Nevertheless, participatory research activities can be considered an important methodological strand in sustainability science, complementing more abstract theoretical-normative thinking as well as modelling work. It contributes significantly to bridging the science–society interface in sustainable development.

The high relevance of participation in sustainability research, driven by the participatory logic of sustainable development as laid down in the Agenda 21, was further fueled and conceptually framed by developments in scientific studies. From the 1960s onwards, the sociology of science and the sociology of knowledge have generated essential insights into the social construction of scientific knowledge [40–42]. This led to a growing awareness that any scientific knowledge is influenced by a variety of cultural, historic and social conditions, thus making it always observer- and context-dependent. From this perspective, instead of claiming objectivity, it is more appropriate to talk about situated, peer-related intersubjective validity. This deconstruction of the way knowledge is constructed in science calls into question the technocratic claims of a hierarchical relationship between scientific and non-scientific knowledge. Conceptual studies made the argument that a hierarchy of knowledge crowned by science is questionable if not inappropriate [43–45]. Recognising non-scientific knowledge claims strengthens methodological pluralism beyond positivist, quantitative-statistical notions of science.

These debates and findings were further developed in the influential publication: The new production of knowledge, which advanced the paradigm of inter- and transdisciplinary Mode-2 science as an alternative to traditional, disciplinary-specific Mode-1 sciences [46]. It provided a forum for discourse on inter- and transdisciplinary approaches in different fields of scientific inquiry, helping legitimise a new way of doing science with stakeholders. Its suitability for sustainability science, which aims at catalyzing solutions to unsustainable developments in cooperation with societal actors, is obvious. Thus, transdisciplinary sustainability science has become an influential academic

program, with significant funding structures, journals, academic positions and innumerable projects worldwide over the past two decades. In addition, beyond the mere involvement of stakeholders from different spheres of society, transdisciplinarity in sustainability science has been combined with the normative-conceptual approach of transition and transformation and the methodology of systems analysis and modelling towards transdisciplinary, transformative sustainability science. Even though the understandings and models of transdisciplinary and transformational sustainability science differ slightly [47], they share a basic logic of a post-positivist pluralism in understanding and shaping the world through different forms of knowledge and ideas. They should be about the participation of stakeholders from different academic and non-academic backgrounds in research and development processes; an openness to different kinds of knowledge claims, including indigenous and non-Western forms of knowledge, and normative preferences; and a solution orientation that goes beyond abstract analysis.

However, transdisciplinary transformational sustainability science as practiced today has a methodological limit regarding its (re-)production of knowledge claims. In general, when it comes to established scientific procedures, norms and criteria, transdisciplinary transformational sustainability science appears little different than “normal science”. Wiek and Lang [48] (p.33) argue that, “for transformational sustainability research ... it is important to develop clear methodological guidelines (as it is important for any other field)”. Such guidelines provide researchers with instructions and quality criteria on how to conduct transformational sustainability research” and “the key condition is that the respective research activity adheres to quality criteria, including validity, reliability, saliency and so forth” and “transformational sustainability research develops evidence-supported solution options for sustainability problems. It shares with descriptive-analytical research the intention to provide credible knowledge, i.e., sufficient evidence for the effectiveness of the interventions”.

From this perspective, transdisciplinary transformational sustainability science is about the scientific construction of evidence-based, solution-oriented knowledge by including stakeholder knowledge, values and normative preferences in a procedure guided by (traditional) scientific criteria. It is a rational and cognitive-based procedure for transforming a situation. The limit of transdisciplinary transformational sustainability science today can be seen in a hesitation to transgress more radical methodological boundaries into alternative ways of multisensorially experiencing the world and gaining insights and representations beyond cognitive (re-)construction and abstraction.

Looking at these conceptual and methodological developments which guided sustainability research and led to the formation of sustainability science over the past quarter century, we can conclude a bias towards cognitivism. It seems that participatory sustainability research and transdisciplinary, transformative sustainability science has followed predominantly—but probably mostly implicitly—the so-called “linguistic turn” pointing to the role of (rational) discourse between actors from different societal spheres. More recent “turns” in social science and humanities, such as “practice turn” [49], “materiality turn” [50] and even more importantly “sensory or affective turn” [51] are less prominent in sustainability science and have not been conceptually and methodologically systematised despite the pioneering works mentioned above.

3. Sensory Sustainability Science—Theoretical and Methodological Considerations

In order to systematically elaborate the perspective of sensory sustainability science, essential conceptual and methodological approaches of social sciences which are particularly relevant to understanding the sensory dimensions of human life are discussed. Based on these insights, it will be argued that a more sensory approach might be fruitful for sustainability research, and key features of sensory sustainability science will be presented.

That humans are not only cognitive information processing machines but multisensorial beings constituted by complex, interrelated cognitive, emotional, affective, corporal conditions is no exciting news. As with other fundamental insights guiding western thinking, until today it was Aristoteles who systematically speculated first about the basic senses of taste, smell, touch, hearing and viewing.

Despite this early recognition of multisensorial human nature and reality, the focus of modern (social) science, however, has been directed since Descartes towards rationalism and cognitivism. The senses were overwhelmingly seen in a critical manner or ignored; it was about civilization (mind) against nature (body) [52] (p. 14f). In the 19th and 20th century, nevertheless, philosophers pointed to the fundamental role of sensory experiences, corporality, affect and emotions for human existence [53,54]. Meanwhile, psychology, most famously represented by Sigmund Freud [55], analysed phenomena beyond cognitive processes and awareness on the level of the individual, the philosophy of phenomenology, strands in anthropology, and some sociologists reflected on the social dimensions of the senses. Herein, some researchers discussed corporal-sensorial experiences only marginally, meanwhile others focused explicitly on dimensions of human life which go beyond cognitive realities. Karl Marx, for example, pointed to the role of adversarial corporal-sensorial experiences of wagedworkers in factories due to the instrumentalisation of bodies by the capitalist system, which contributes to the feeling of alienation [56]. More systematically than Karl Marx did in his wide ranging analyzes of capitalism, the philosophical school of phenomenology and the anthropological philosophy examined the fundamental relevance of senses and corporality for human existence [53].

Based on Husserl's phenomenology of intersubjectivity, in which he emphasises the foundational function of mutual influencing corporality and sensory perception for mentally conscious experiences and interactions, it was phenomenologist Maurice Merleau-Ponty [54], a student of Husserl, who further emphasised the key relevance of corporality and sensory dimensions for social life. He elaborated a differentiated conceptualisation in which he put corporality, understood as sensing flesh, as mediating an entity between mind and body, and with it, as being constitutive for experiencing material and social worlds. His central claim, that humans do not (only) have bodies, but are bodies, which is fundamental for the idea of being-in-the-world as body-subjects, emphasises the relevance of the corporal-sensory dimension of human life and discloses a shortened cognitivism.

That the sense of human senses goes beyond the function of being just an information provision infrastructure for cognitive processes of awareness, has been elaborated most famously by Helmuth Plessner [53] in his anthropology of senses. His elaboration of cognitive and corporal co-construction of sense-making, the distinction between sensing and interpreting, intuition and conception, and his aestheseology of mind and corporal senses in which he points out the diversity of senses and its interplay can be read as a call to pay more attention to the multisensorial reality of humans as bodily subjects in a material world. Especially in his discussions of music (auditorial sense) and visual arts (visual sense), the intrinsic value of corporal sensations and sense-making becomes evident.

A specific view on the role of the senses for social interaction was firstly introduced by sociologist Georg Simmel [57]. He focused on how reciprocal sensory perception influences societal life. He argues that the senses function like a bridge between subjects in the social world in a two-sided manner: On the one hand, they lead into the subjects, causing sentiments such as sympathy or antipathy, just by corporal-sensory co-presence; on the other hand, they serve as a bridge to the other self by enabling cognitive-sensory insights and evaluation. Thereby, the visual sense, for which he assumes an immediate situative-orientating function, plays a preeminent role. In contrast, auditive-notional sense-making is considered to have an interpretative-orientating function. Thus, he differentiates between seeing as more intuitive and coarser and hearing/speaking as more rational and differentiated. Even though Simmel discusses other human senses such as taste, smell or kinaesthetics as well, he considers them of secondary importance for social interaction nevertheless. With his early attempt to grasp the role of senses for social reality, Simmel showed that below more abstract societal phenomena such as institutions, systems or discourses, the sensory-based interactions need to be taken into account in order to reach a comprehensive understanding of society.

Based on these basic works in philosophy, anthropology and sociology as well as insights from sensory observations in ethnographic ethnology from the 1980s onwards, the research perspective of interdisciplinary sensory studies emerged [12,58]. Nowadays, sensory studies are a vibrant academic

undertaking, showing that the senses need to be considered as an important basic anthropological constant significantly influencing human life. Grounded in theoretical considerations and concretised by abundant empirical evidence, the interrelatedness of social construction and sensual construction of socio-material reality is shown [59]. Key insights, which are particularly of interest in our context, are the cultural variation in visual and social order; the identification and problematisation of sensory scapes such as visual scapes, auditive scapes and smell scapes; the social and sensory differentiation and sensory specialisation in subcultures and professions; and the finding that—despite the neurobiological basis of senses—sensory perception is always socially and culturally mediated and shaped by political forces and power relationships.

Of special interest in regard to the natural and built environment, and hence for sustainable development, is the perspective of atmosphere [14,60]. This conceptual approach has been developed over the past 50 years. Based on a critical contestation of the traditional philosophical separation of physics as the domain of the material world of objects and psyche as the domain of the inner world of subjects, the claim is made that human reality is pre-cognitively influenced by its spontaneous life experience as bodily beings through atmospheres, which are thought of as co-constructed phenomena emerging between material carriers of moods and corporal-sensorial affectivity preforming emotional conditions, cognitive-interpretations, and by this, shaping human perception and action. The positioning of atmospheres as something co-processed between sensing (human) subjects and mood-carrying material and social worlds is substantiated by the concept of synesthetic characters and movement suggestions [61]. It is assumed that material and social worlds provide thick sensory scapes: visual scapes, sound scapes, smell scapes and touch scapes, which represent specific synesthetic characters and are spatially pre-framed by movement offerings as movement suggestions which are (primarily) corporally sensed by humans always placed in a concrete socio-material environment. This theoretical-conceptual thinking has been exemplified by reflections on a broad range of selected “atmospheres”. The spectrum ranges from discussions on nature-related atmospheres co-shaped by weather, landscapes, forests, oceans, through architecture or interior furnishing, for example the specific atmosphere in lower-middle-class houses, up to atmospheres in sport events, for example bodily synchronisation of fans in a football stadium [14]. In all of these theoretical considerations and exemplified concretisations, the key insight is, in line with Merleau-Ponty, that human reality is physical and the corporal is decisive. Beyond the conception of man as a rational being, it is emphasised that spontaneous human life experience is characterised by sensing beings in sensible socio-material environments scientifically captured as atmospheres.

The relevance of corporality and materiality for social action, emphasised by these (neo-)phenomenological and sensory approaches, is shared by sociological practice theories as well [13]. With distinction to key perspectives in social theory such as rational choice, norm-oriented, mentalist, textualist traditions, which focus on the (cognitive) human exceptionalism of abstract-cognitive thinking, rational decision-making, symbolic information processing and intentionality, sociological practice theories have carved out the implicit informal logic of social life driven by routinised social practices based on embodied knowledge. Beyond abstract-cognitive thinking and derived action, the role of concrete-practical corporal doing in particular socio-material situations is underlined. Bourdieu’s [33] habitus approach, Latour’s [42] actor-network-theory or Haraway’s [61] conceptualisation of hybrids and cyborgs help to better understand the forceful, too often overlooked, undercurrents of social action, especially the influence of unreflected embodied knowledge as well as the action capacity of non-human entities. The central difference to the (neo-)phenomenological and sensory approaches is, however, that the focus is on implicit, embodied knowledge and practical ability but not explicitly on sensory-affective dimensions.

The most recent theoretical approach, which provides a fruitful impulse for conceptual considerations regarding sensory sustainability science, is the theory of resonance recently introduced by sociologist Hartmut Rosa [15]. The corporal, sensory, material perspectives discussed so far have been employed in the theory in order to bring forward the central argument that humans

are anthropologically oriented towards resonance. Resonance is defined as a specific form of relationship between subjects and their worlds (human and non-human) which materialises beyond cognitive-interpretative perception essentially through emotional and corporal-affective sensed forms of reverberations of lived experiences. It is about a mode of connection characterised by reciprocal affect, where no side has complete control over the other. A theoretical distinction is made between mute and resonant forms of world relationships. Mute world relationships are caused by instrumental, objectified relations; meanwhile, resonant relationships are characterised by touching appropriation and reciprocal transformation. Instrumentalised work-place situations, in which workers are just expected to function and which may result in alienation, or unreflected (status) consumerism can be understood as mute relation. Actively engaging oneself as a mental-corporal being into world relationships, driven by intrinsic interest and self-efficacy expectations with openness to be touched by the world's own voice, such as by gardening, playing sports or an instrument; interacting reciprocally with family, friends, colleagues; or fulfilling a sense-making occupational task, leads to resonant world relationships. Based on this basic conceptualisation, the theory differentiates three key axes of resonance: horizontal resonance capturing resonant social relationships between family, friends and democratic participation; diagonal resonance capturing material or object relationships at work, consumerism or sports; and vertical resonance capturing the more encompassing, time-related contexts in which subjects are embedded: religion, nature, arts and history. With this theoretical equipment, the dynamic of instrumental enhancement in late capitalist modernity is criticized as a way towards mute world relationships, because spheres of resonance are at risk. Beyond the previously discussed approaches, the theory of resonance provides a further aspect by reconstructing the quality of relationships between subjects and their (human and non-human) as resonance, hereby emphasising the indivisible double-sidedness of evaluative-cognitive and corporal-affective existence of always materially, culturally and socially embedded and coined humans.

The anthropological and sociological reflections discussed so far challenge mentalist, textualist or rationalist conceptualisations of human exceptionalism. They provide strong arguments to take into account more explicitly the irreducible corporal-affective, multisensorial reality of life as well as the capacity of the non-human world of biological and physical objects not only to “act” but to serve as a carrier of “affection”, co-constructing atmospheres and resonance together with sensing humans. This social theoretical thinking means nothing less than proposing an idea of man and society which highlights the non-cognitive dimensions of socio-material interaction: Humans are conceptualised neither as cognitive information-processing machines nor only as psychological beings with specific emotions; they are perceived as multisensorial by nature, and their multisensorial experience and perception is thought to be inevitably immersed into an always given social, cultural and material web of life.

These theoretical approaches, which have gained attention over the years, without doubt have contributed to a more encompassing theoretical understanding of social life. However, it poses significant challenges to empirical analysis. Dominant research methods in social sciences, especially quantitative survey research and qualitative interviews or quantitative and qualitative content and discourse analysis, are of limited value due to their mentalist and textualist focus. Different theoretical perspectives require different methodological entrances. The methodological focus needs to be shifted towards grasping the multisensorial reality of life. Away from established methods in social sciences, innovative methodological experimentation addressing multisensoriality has taken place over the past 20 years. Particularly promising in this regard are the methodologies of sensory ethnography and arts-based research.

Ethnography developed as a qualitative-interpretative research approach in ethnology during colonial times [62]. Ethnologists undertook research expeditions, most often supported by vested interests of colonial states, to observe “exotic” cultures and gain a more detailed understanding of their practices, rituals and cosmologies. Beyond the methods of taking field notes based on observations, conducting (narrative) interviews or drawing humans and their physical environment, technological

progress has been continuously adopted. Especially photography as well as audio and audio-visual recording techniques have been employed to comprehensively capture the unfamiliar life worlds [63]. Moreover, the method of participatory observation in order to gain deep understanding of the meaning behind visible practices became common place in ethnological ethnography. With the application of these methods over time, the objectivity of the (participatory) observer and its observation were questioned. The role of the researcher and its social impact within participatory observation were critically discussed, which finally led to a more (self-)reflexive ethnography [62].

The ethnographical way of doing research—explorative, observant, participatory, interpretative, qualitative—has spread beyond ethnology and the analysis of “exotic” cultures since the beginning of the 20th century. In anthropology and sociology, especially in urban sociology and sociology of everyday life, the ethnographic methodology has been employed to reconstruct societal practices and its particular (sub-)cultural meaning [64]. Beyond the cognitive-represented and in surveys expressed opinions, attitudes and value-orientations of people are in these studies of specific interest the societal practices and the embodied implicit knowledge. Thus, ethnographic sociology provides an approach to grasp societal routines in its material environments and illuminate macrosociological conditions within microsociological concretisation.

A further development of ethnography has taken place over the past two decades related to the insights of sensory studies and the heightened attention on corporal-sensory dimensions of human action. The approach of sensory ethnography emphasises the relevance of multisensoriality for human life [64]. In this methodological perspective, the different senses—smell, taste, visual, audio, touch, kinesthetic—their interconnection with each other and their relation with key aspects of human existence such as perception, place, knowing, memory and imagination are put at the center of ethnographic inquiry. By shifting the ethnographic focus more explicitly to the sensory experiences, ethnographic research is challenged to renew its ways of observation and interpretation of ‘outlandish’ social practices. Beyond cognitive reconstruction and interpretation of social action, it is about lifting the often unnoticed, invisible sensory and affective aspects in socio-material practices. The addressing of corporal-sensory life experience stimulated a new level of ethnographic (self-)reflection and innovation of methods [64]. The spectrum ranges from greater sensitivity towards autoethnography, gendered ethnography, interventionist ethnography, up to creative use of digital media technologies such as eye-tracking or smartphones in participatory audio-visual recording. Regarding the irreducible corporality of human existence, audio-visual ethnographic methods are considered to play an especially important role in order to capture corporal behavior in its physical environment.

The production, representation and communication of sensory ethnographic insights transgresses proactively in significant ways traditional forms of positivist, number- and text-based, scientifically-styled knowledge creation through distant researchers. Through creative methodologies and imaginative practices, from walking as an ethnographic strategy, to (fictional or poetic) writing, up to performances and (experimental) recording and editing, interpretative horizons are opened up and the potentiality of societal practices is explored in collaborative processes between researchers and research subjects [65]. This way of performing sensory ethnography overlaps with the second methodological perspective considered here, specifically promising to contribute to a more full understanding of multisensorial human realities: arts-based research.

Arts-based research (ABR) is a relatively new methodological paradigm in social and cultural sciences. It has its roots in early attempts of individual researchers at the fringes of their disciplines to avoid scientific reductionism by using methods of the creative arts to gain more holistic insights into human experiences and practices. Alongside individual outsider scientists who refused to play by the (academic) rules of the game and were brave enough to cross methodological boundaries, a second driver for arts-based research came from developments in arts therapy from the 1970s onwards [66]. Findings in psychology and research on social work show that the creative arts—whether it be visual arts, theatre, dance or fictional writing—have significant potential for initiating critical (self-)reflection, thus opening up new perspectives in psychological and social therapies. In the 1990s, arts-based

research finally developed into its own branch of qualitative social science research [67]. Since then, there has been an ongoing process of differentiation and professionalisation, providing a theoretical foundation and a set of arts-based research methods that allow its use in a wide range of social science disciplines. Thus, arts-based research is now considered a creative research practice providing an alternative way of knowledge production and communication alongside traditional quantitative and qualitative scientific methodologies.

Arts-based research provides an alternative methodology in which scientific and artistic ways of sense-making converge. It is about aesthetic knowing and aesthetic practice. Aesthetic is used in this context in its basic meaning of sensory perception and intuition. Scientific inquiry can be enriched by artistic ways of knowing, because they complement scientific procedures which are generally abstract, reductive, cognitive and verbalised [17] (p. 20). Arts-based research:

- recognises that art has always been able to convey truth(s);
- recognises that the use of the arts is critical in achieving self/other knowledge;
- values preverbal ways of knowing;
- includes multiple ways of knowing, such as sensory, kinesthetic and imaginary

Thus, arts-based methods allow for a more holistic understanding as they open up an alternative way of understanding and interpreting reality, reveal multiple meanings of phenomena and strengthen empathetic awareness-raising.

Patricia Leavy differentiates eight fields of arts-based research: narrative inquiry, fiction-based research, poetry, music, dance, theatre, film and visual art.

Regarding fiction-based research, Leavy [17] (p. 55/56) argues: “Fiction as a research practice, based on narrative inquiry, is well suited for portraying the complexity of lived experience because it allows for details, nuance, specificity, contexts, and texture; cultivating empathy and self-reflection through relatable characters; and disrupting dominant ideologies or stereotypes by showing and not telling”. The potential of fiction to create condensed descriptions by means of composite characters and internal monologues to portray the messiness and contradictions of real-world experiences may provide new insights through a more empathetic understanding. At the same time, it fosters outreach beyond specialised scientific communities because novels serve as entertainment as well as (self-)reflection. The key difference to the work of a professional novelist is that the starting point in ABR is a scientific topic and question and that scientific literature, concepts and empirical studies are consulted to create the work of fiction. Through a process of narrative inquiry and observation of interactions, a work of fiction is constructed, its format shaping the production of knowledge while creating distinct insights and communicative power.

Other arts-based methods go beyond textual approaches involving narratives, fiction or poetry to address other sensorial modes. Music, for example, makes use of sound, melody and rhythm, and is often combined with language, to bridge cognitive and emotional dimensions. This method has proven to be especially fruitful in projects with marginalised groups to gain insight into and increase self-awareness of situated circumstances as well as to express experiences, intuitions, emotions and perceptions in a multisensorial way. Music history is full of examples of cultural criticism that impact people on both an intellectual and an emotional level.

Theatre and film address even more senses because language, movement, visual impression, sound and tactile experience—imagined or real, such as in participatory theatre—are merged, thus bringing it closest to everyday multisensorial experience. In addition, through dramaturgy and plot—in analogy to narrative inquiry and fiction-based research—insights can be created and communicated in an aesthetic manner. It is important to note that theatre and film, as the other arts-based methods, are understood in this context not only as tools for representation and the communication of social scientific insights, but as a research approach in their own right. The process of creating a play based on a scientific topic or question using the investigation and interpretation of data and information from various sources is itself a form of research. It has the aim of discovering new insights and presenting

them to the public in a different way than the usual academic research-and-publish format. Similar to literature or music, the history of theatre and film is full of examples of critical reflections on social, economic or ecological real world challenges.

The broad field of the visual arts—ranging from painting through installations, artistic film and digital media, to performances—provides a rich array of resources for arts-based research as well. The line between theatre and film and another arts-based method, visual art, is sometimes blurred; yet depending on the type of social scientific research being carried out and the specific question at hand, the radical freedom of visual arts allows for the greatest creativity in the production and communication of insights in diverse sensorial ways.

In contrast to these arts-based methods, dance and movement are explicitly non-verbal. This does not hinder dance, especially modern dance, from providing opportunities to critically investigate and represent embodied knowledge, embodied habitus and cultural norms. Given that routines as embodied habitus and social practices are a key challenge to unsustainability, they could be explored and represented through bodily performances and transformations of bodily behavior in space and time. As with other arts-based methods, however, dance and movement are certainly not capable of contributing insights and delivering an aesthetic form of representation to every kind of research question.

As in every good research practice, an arts-based method should be carefully selected with regard to the object of investigation. Along with quantitative and qualitative methods in the social sciences, arts-based methods provide new possibilities for producing and communicating knowledge. If a decision is made in favor of arts-based methods in a specific research project, then, in a second step, the most appropriate arts-based method must be carefully selected. However, the selection of a method is not usually determined by the objective and the research question. In research practice, it is the resources: time, skills and funding, that influence the selection of a method. This is especially true for the use of arts-based methods. Without doubt a professional novelist, filmmaker, theatre dramaturg, choreographer or visual artist with their training and talent will be better equipped to produce novels, films, plays, dance performance or paintings with higher aesthetic quality than a scientist. On the other hand, researchers with their training and expertise are better prepared to formulate research questions in their respective fields. There are basically two ways of dealing with the issue of competence and skills in arts-based research. Either the researcher collaborates with an interested artist and their areas of expertise complement each other or the researcher develops skills and competences in a specific arts-based method, for example by learning creative writing techniques, and produces a scientific work of fiction. Both options certainly have advantages and disadvantages. Ultimately, what is most important is the recognition that arts-based research is a hybrid of the arts and science. Scientific research should be oriented towards artistic aesthetics because the goal is to produce and communicate knowledge in a multisensorial way.

By creatively employing artistic methods in social scientific inquiry, an alternative form of production of knowledge and communication has been developed over the past two decades. Arts-based research now provides, despite some overlaps with the logic of qualitative-interpretative research, a distinct methodological approach alongside traditional quantitative and qualitative methodologies as pointed out by Leavy (Table 1).

The theoretical and methodological considerations discussed so far have aimed at mapping out interesting developments in social sciences over the past decades, which may help to pave the way towards a more sensory sustainability science. The theoretical insights about the role of corporal, sensorial, affective, atmospheric dimensions in societal practices as well as the relevance of cognitive-corporal resonance for human relations to its worlds and the methodological methods to approach through sensory ethnography and arts-based methods, the theoretically captured multisensorial reality of human life reveals the potential of this epistemological perspective for sustainability science. Sustainability science deals specifically with (un)sustainable social practices regarding the build and natural environment, with (un)sustainable and (un)just interactions

between humans and non-human entities, and aims at providing solution-oriented, transformative knowledge. However, these challenges are overwhelmingly approached in sustainability science through normative, discursive, textualist, mentalist ways. Taking seriously the theoretical and methodological considerations presented here, the, at least partly unconscious, multisensorial experiences in (un)sustainable practices should be moved from the margins somewhat more to the center. Looking at sustainability issues through the lens of sensory sustainability science, grounded in the outlined theoretical and methodological approaches, a wide range of research topics arise, for example: corporal-sensorial manifestations in varying mobility options; atmospheres in nature-, land- and city-scapes; resonance in human/non-human interactions; multisensorial dimensions in varying occupational and consumption practices; sensory scapes of places: smell, taste, touch, sight, hearing and kinesthetic; relationship between virtual (mediate) and real (immediate) multisensorial phenomena; socio-cultural diversity of corporal-sensorial experience, cognitive evaluation and imagination. These prime examples may indicate the potential of sensory sustainability science to open up a new, complementary perspective for scientific engagement on sustainable development.

Table 1. The following table gives an overview of the specificities of arts-based methods compared to quantitative and qualitative methods (Leavy 2015, p. 294).

Quantitative	Qualitative	Arts-Based
numbers	words	stories, images, sounds, scenes, other sensory inputs
data discovery	data collection	data or content generation
measurement	meaning	evocation
tabulating	writing	(re)presentation
value neutrality	value non-neutrality	political/emancipatory consciousness
reliability	process	authenticity
validity	interpretation	truthfulness
proof	persuasion	compelling/moving/aesthetic power
generalisability	transferability	resonance
disciplinarity	interdisciplinarity	transdisciplinarity

4. Outlook

In the face of persisting unsustainable developments around the world, sustainability actors are challenged to reflect their activities and explore additional and new ways to drive sustainable development. Not least, this is true for sustainability science as well. Sustainability science has developed over the past 20 years into an innovative and vibrant academic field. It has repeatedly created new methodological approaches, such as the move towards transdisciplinary transformative sustainability science, and continues to experiment with new ways in research and development. There is now a striking diversity of methods being employed in this field. However, sustainability science is about the scientific construction of evidence-based, solution-oriented knowledge by including stakeholder knowledge, values and normative preferences in a procedure guided by (traditional) scientific criteria. Thus, it is basically about gathering valid and reliable data generated by quantitative and qualitative methods in a participatory process; making a text-based scientific argumentation reflecting abstract, rational and cognitive procedures for transforming a situation or recommending a solution; and then communicating knowledge mainly through traditional academic publishing practices. In this sense, the limit of sustainability science today can be understood as a hesitation to transgress more radically theoretical and methodological boundaries into alternative ways of accessing the world and gaining insights and representations beyond cognitive (re-)construction and abstraction. Surely, there are creative projects and studies working with practice theory, ethnographic or arts-based methods in sustainability research as has been referred to at the beginning of this article. However, there is lots of room for a wider and more systematic application.

Sensory sustainability science should shine more light on blind spots in sustainability discourse and practice by reflecting and focusing on underrepresented aspects of human behavior in

socio-environmental contexts. Thus, strengthening sensory sustainability science could help to expand the agenda of research and teaching on sustainable development and create new insights and options for societal sustainability practice. However, even though there is, as has been shown in the article, a growing body of knowledge and experience in social sciences and humanities with sensory and arts-based research, teaching in general and some activity in sustainability science as well, the current funding structures, institutional settings and publication practices seem to not be in favor of sensory sustainability science. Despite the fact that some opening towards inter- and transdisciplinarity has taken place, research funding and publication practices are apparently still very much oriented towards established scientific criteria and routines. Moreover, the disciplinary compartmentalisation in science institutions, which already poses a challenge for interdisciplinary research and teaching, poses an even bigger challenge to transgress the borders towards the realm of arts with its aesthetic-sensory focus. A key issue for the further dissemination and establishment of sensory sustainability science certainly will be a more systematic reflection on quality and evaluation criteria. It is obvious that established scientific quality criteria and review processes need further development in order to safeguard and allow for good practice in sensory sustainability science and to prove the relevance and added value of this conceptual and methodological perspective. Starting points for this debate would be next to the more specific proposals for quality criteria in arts-based methods or sensory ethnography, criteria sets which provide a universal framework for ensuring quality in the pluralistic field of qualitative research [68]. In addition, beyond the use of these types of quality criteria sets, which should help guide the design, conduct high-quality sensory sustainability research and teaching and provide a basis for external evaluation of projects, re-thinking the procedures of current evaluation and review processes seem to be necessary as well. Hereby, sensory sustainability science should be open to learn from arts and their evaluation practices.

The theoretical and methodological considerations discussed in this article may help to enable a more systematic sensory sustainability science. It opens up the epistemological perspective from a mentalist, textualist, discursive, rational idea of man towards emphasising the corporal-sensorial affective dimensions of human action in routinized socio-material practices. Thus, it would allow for a more balanced, encompassing understanding and reflection of (un)sustainable societal developments and provide new ways for transformative efforts.

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